to employ the correct value of the Sun's mean longitude. At the present time Bessel's value of the Sun's mean longitude is about $0^{s}\cdot 6$ in error, and therefore the mean solar time inferred by means of it from the sidereal time would be in error to the same amount. The mean longitude found from Le Verrier's Tables is much nearer to the truth, and therefore the mean solar time found from the sidereal time by using this value would be much more nearly correct.

It must not be forgotten however that, as we have already stated, the mean solar time may be derived from observations of the transit of the Sun over the meridian, without employing the sidereal time at all. Apparent solar time, which is found directly from observation of the Sun is converted into *mean* solar time by applying the equation of time, which is known from the solar theory, without reference to the sidereal time.

On the Change in the Unit of Time implied in the Substitution of Hansen's for Bessel's Expression for the Longitude of the mean Sun. By Prof. A. Cayley, M.A., F.R.S.

I have before me Mr. Stone's paper "An Explanation of the Principal Cause of the Large Errors &c.", *Monthly Notices*, vol. xliii. (1883) pp. 339–345, in which Mr. Stone arrives at the conclusion that the effect of the substitution of Hansen's expression for the longitude of the mean Sun in place of that of Bessel is to change the unit of time in the ratio of $1+x$ to 1, where

$$x = -\frac{0\cdot 055871}{1296027\cdot 674055}.$$

Prof. Adams considers, I think rightly, that the true value of x is about $\frac{1}{365}$ of this value.

I wish in the present paper to present the question in what appears to me to be the most distinct manner.

Bessel's expression for the longitude of the mean Sun, 1850 Jan. 1, Paris mean noon $+t$ is

$$l = 280^{\circ}\ 46'\ 36''\cdot 12 + 1296027''\cdot 618184\,.\,t + 0''\cdot 0001221805\,.\,t^2,$$

say $\quad = \quad$,, $\quad + \mathrm{L}t \quad$,,

the unit of time being *supposed* to be a Julian year of $365\cdot 25$ mean solar days, and only the term in t being here attended to.

I infer that according to Bessel the Sun's mean hour-angle from the meridian of Paris would be

$$h, = 365\cdot 25 \times 360^{\circ}\,.\,t,$$

viz. t increasing by $\dfrac{1}{365\cdot 25}$ (=one mean solar day) h would increase by 360°. Say this value is $h = \mathrm{H}t$.

The Right Ascension of the mean Sun is equal to the mean longitude l; and hence the Right Ascension of the meridian of Paris is $h+l,=(\mathrm{H}+\mathrm{L})t$; or reckoning from a fixed equinox instead of the mean equinox, this is $h+l$—a term depending on the precession$=(\mathrm{H}+\mathrm{L}-\varpi)t$; $\varpi=50''\cdot 21129(1-\cos\omega)$, where $50''\cdot 21129$ is Bessel's value for the general precession.

Hence

$$(\mathrm{H}+\mathrm{L}-\varpi)t=\text{Bessel's value for Earth's rotation in } t \text{ Julian years.}$$

Similarly, Hansen's expression for the longitude of the mean Sun, 1850 Jan. 1 Paris mean noon$+t'$, is

$$l'=280^\circ\ 46'\ 43''\cdot 20+1296027''\cdot 674055\,.\,t'+0''\cdot 0001106850\,.\,t'^2$$

$$\text{say} \quad = \quad \text{,,} \quad +\mathrm{L}'t' \quad \text{,,}$$

the unit of time being *supposed* to be a Julian year of 365·25 mean solar days; and only the term in t' being here attended to.

I infer that according to Hansen the Sun's mean hour-angle from the meridian of Paris would be

$$h'=365\cdot 25\times 360^\circ\,.\,t',$$

viz. t' increasing by $\frac{1}{365\cdot 25}$ (=one mean solar day) h' should increase by 360°. Say we have $h'=\mathrm{H}'t'$. H' is$=\mathrm{H}$, but for convenience I use the accented letter.

As before, the Right Ascension of the meridian of Paris, reckoned from a fixed equinox, is $h'+l'$—a term depending on the precession,$=(\mathrm{H}'+\mathrm{L}'-\varpi')t'$ $\varpi'=50''\cdot 224(1-\cos\omega)$, where $50''\cdot 224$ is Hansen's value of the general precession.

Hence

$$(\mathrm{H}'+\mathrm{L}'-\varpi')t'=\text{Hansen's value of Earth's rotation in } t' \text{ Julian years.}$$

Now, Bessel's mean Sun is not Hansen's mean Sun, and a Julian year (Bessel) is not=a Julian year (Hansen). In order to determine the ratio of the two Julian years (or say the ratio of the two units of time) Mr. Stone compares the motions in longitude $\mathrm{L}t$, and $\mathrm{L}'t'$ of the two mean Suns; but this assumes that the two mean Suns are identical, *which, as just remarked, is not the case.* Admitting that they were so, and neglecting with Mr. Stone the difference of precession the ratio would be

$$\frac{\mathrm{L}'}{\mathrm{L}},\ =1+\frac{\mathrm{L}'-\mathrm{L}}{\mathrm{L}},\ =1+\frac{0''\cdot 055871}{\mathrm{L}},$$

The proper equation for the comparison of the units is afforded by the expressions for the time of the Earth's rotation; consider a *definite* interval of time (=about one Julian year), and say this is the adopted Julian year; and suppose

$$\text{Julian year (Bessel)} \ =(1+x) \text{ adopted year.}$$

$$\text{,,} \quad \text{(Hansen)}=(1+x') \quad \text{,,}$$

Then in one adopted year

$$\text{Rotation (Bessel)} = \frac{H + L - \varpi}{1 + x}$$

$$\text{,, (Hansen)} = \frac{H' + L' - \varpi'}{1 + x'}.$$

And we thus have

$$\frac{1 + x'}{1 + x} = \frac{H' + L' - \varpi'}{H + L - \varpi}, = 1 + \frac{H' - H + L' - L - (\varpi' - \varpi)}{H + L - \varpi}.$$

Here

$$H' = H, = 365 \cdot 25 \times 360^\circ = 131490^\circ, = 473364000'', H + L = 474660027,$$
$$= \text{about } 366L:$$

hence we have

$$\frac{1 + x'}{1 + x} = 1 + \frac{L' - L - (\varpi' - \varpi)}{366L}.$$

Or neglecting as before $\varpi' - \varpi$, the ratio is

$$= 1 + \frac{0''\cdot 055871}{366L};$$

viz. the alteration of ratio is $= \frac{1}{366}$ of the value found by Mr. Stone. As regards the term $\varpi' - \varpi$, Bessel's precession is $50''\cdot 21129$, Hansen's $50''\cdot 224$, whence

$$\varpi' - \varpi = 0''\cdot 01271 \ (1 - \cos 23^\circ \ 28') = 0''\cdot 01271 \times \cdot 0898, = 0''\cdot 00114;$$

so that instead of $0''\cdot 055871$ the numerator should be $0''\cdot 05473$.

The Orbit of the Great Comet (*b*) 1882. By J. Morrison, M.A., M.D., Assistant on the *American Ephemeris and Nautical Almanac*, Washington.

(*Communicated by the Foreign Secretary.*)

Ever since the discovery of this remarkable comet in the early part of September 1882, numerous efforts to determine the elements of its orbit have been made by astronomers in different parts of the world, and in no similar case has there been, we believe, a greater disparity in the results obtained. An orbit like the one under consideration, which is so situated with respect to the orbits of the planets that the effect of planetary perturbations is absolutely inappreciable, must furnish a good example of pure and undisturbed elliptic motion, and therefore we would naturally expect that a system of elements computed from three or four good observations suitably selected would very nearly, if not exactly, represent its motion. In this expectation, however, we are disappointed, for no orbit has hitherto been published which completely satisfies the observations, especially those made after the middle of October or thereabouts. From the time of discovery until about this date the nucleus